Water Acquisition and Management Subcommittee Position Paper: Supplementing Middle Rio Grande Flows through Groundwater Pumping

Introduction

The ESA Collaborative Program is exploring options for maintaining flows in the Rio Grande for endangered species. Groundwater pumping has been proposed as an option that could be used to supplement river flows during periods of low flow. This pumping could include:

- Pumping of shallow, alluvial groundwater: intermittent pumping from existing or new shallow alluvial groundwater wells in the Middle Rio Grande floodplain, allowing wells to recharge naturally during periods of non-pumping;
- Pumping of non-alluvial groundwater with natural recharge: intermittent pumping from non-alluvial wells in the Middle Rio Grande floodplain, or at locations further from the river, allowing wells to recharge naturally during periods of non-pumping;
- Pumping of non-alluvial groundwater with active recharge (aquifer storage and recovery): intermittent pumping from non-alluvial wells, coupled with active recharge of the aquifer during periods of non-pumping (i.e. development of an aquifer storage and recovery system); or
- Pumping and Desalinization of Deep Saline Groundwater: pumping and desalinization of deep, saline groundwater, and use of the desalinized water as needed to support river flows.

The primary constraint on the first three of these options is water availability. It is well known that the surface water and groundwater supplies throughout the Middle Valley are, in almost all areas, hydraulically connected. It is also well known that surface-water supplies in the Middle Valley are fully appropriated. Consequently, application of any groundwater pumping plan involving one or more of the first three options would need to do one of the following:

- utilize water contained in the basin that is currently unappropriated;
- affect water timing only, incurring little or no additional water loss to the system;
- incorporate leasing, or buying and retiring, water rights to offset the consumptive use incurred by the plan; or
- mine groundwater resources, which will deplete streamflow at some point in the future.

The fourth option, pumping of deep, saline groundwater, involves mining of a groundwater resource, but would mine a new source of water to this system, and would be designed so as not to impact streamflows in the foreseeable future (the effects may not be felt on the river for centuries). All of these options would require approval from the New Mexico Office of the State Engineer (OSE), and the operations would be under the jurisdiction of the OSE.

Pumping of shallow, alluvial groundwater

Pumping of shallow, alluvial groundwater could be utilized as a short-term method for supplementing river flows during times of low flow. This option should be viewed as a management option during critical low-flow periods only, although it could be valuable for this purpose. Shallow alluvial wells in the MRG valley can be pumped at rates up to about 1,000 gallons per minute – therefore, even the high-production wells could contribute at most approximately 2 cfs to the river. These rates are sufficient that a wellfield or series of wells could provide water during emergency situations on the river during low-flow or drying events, or to provide localized flooding to support Southwest Willow Flycatcher habitat, but would not be anywhere near sufficient to provide overbank or spawning flows.

A program of pumping of shallow, alluvial groundwater could be administered in a number of ways, including:

- Pumping from shallow alluvial wells, and discharging the pumped water directly into the river,
- Pumping from shallow alluvial wells and discharging the pumped water into MRGCD drains that discharge to the river further downstream.
- Pumping from riverside drains or other valley drains into the river in order to supplement flows in critical reaches, as is presently done from the Low Flow Conveyance Channel (which today functions as a drain). This could be done from other drains in the MRG Valley if the removal of water from a particular drain is determined to not adversely impact downstream irrigators and the operation of the MRGCD.
- Supply of some irrigated acreage through pumping of a farm well, with the arrangement that the irrigator not receive surface-water delivery, but instead forgo the diversion of his farm-delivery allotment from the river. It should be noted that this option shares many of the feasibility concerns inherent in the development of an irrigation forbearance program in the MRG Valley.

None of these options provides a source of new water. Any shallow alluvial groundwater pumping would result in depletion of streamflow in the river at a later point in time, since water would naturally flow from the river, and also possibly MRGCD canals, into the aquifer to replace water that was removed through groundwater pumping. This decrease in streamflow could occur near the location of the pumping, or further downstream. During both application and recovery periods, groundwater elevations would need to be monitored and impacts on the river accounted for. Also, the MRGCD relies on drainflows to provide water to some of its irrigators. Therefore, the impacts of pumping of groundwater or drain water on the operation of the MRGCD would need to be monitored and ameliorated as appropriate.

Wells used for the pumping of groundwater could be either privately owned or developed specifically for river management. The infrastructure required to develop a wellfield for this purpose sufficient to provide meaningful flows would be substantial, and costly. For comparison, the entire City of Albuquerque wellfield combined, with a total of 97 wells, pumps a total of only 140 cfs.

Pumping of non-alluvial groundwater with natural recharge

Pumping of non-alluvial groundwater, including deep water below the floodplain or water from aquifers outside the floodplain, without actively recharging the aquifer, will result in groundwater mining, with eventual resulting decreases in streamflow, which would be first noticeable several years to several decades in the future. In a fully appropriated basin, these decreases would necessarily result in the denial of water to valid water-rights holders in the future. This approach is not recommended, and would be unlikely to be approved by the OSE.

Pumping of non-alluvial groundwater with active recharge (aquifer storage and recovery)
Under this alternative, during periods when unappropriated water is available, this unappropriated water would be used to recharge the aquifer. This recharge could be accomplished through injection wells, or infiltration from basins. During periods of low flow, this water would be withdrawn and pumped into the Rio Grande Floodway to maintain flows. Though a more expensive option than either alluvial or non-alluvial groundwater pumping without active recharge, this option offers the opportunity to bank water for future use rather than run a short or long-term water deficit that requires repayments.

The biggest problem with this option is that it requires unappropriated water in the system that can be banked. Water rights could be purchased for this purpose. It has also been proposed that unappropriated water be banked during times of excess water. The following section describes the limitations on the availability of unappropriated water that can be banked.

Utilization of unappropriated water:

Ideally, banked water would be basin water that is currently unappropriated. Since the Middle Rio Grande is a fully-appropriated system, and the Rio Grande Compact caps Middle Valley water usage at 405,000 acre-feet for Otowi Index flows in excess of 1.1 million acre-feet, only during spill years does the Middle Valley even potentially have access to more than 405,000 acre-feet of water from the Rio Grande. And even in a spill year, the practical and administrative availability of any additional water has yet to be proven through the vetting of an application for its use through the OSE.

Spill years have occurred 6 times since the Elephant Butte Reservoir was constructed. It is unlikely that aquifer storage of excess water in a spill year is a viable option given this type of return period for flows. Although the total volume of water spilled since 1982 is significant -- approximately 1.4 million acre-feet, or an average of 70,000 acre-feet per year -- this does not mean that this water would be available for appropriation in the basin. Any evaluation of extra water potentially available would have to consider all of the provisions of the Rio Grande Compact, not just the amount of water that actually spilled. New Mexico could not, for example, take water for storage and in so doing prevent a spill without the concurrence of Colorado. Also, the 1982-2001 period has been particularly wet, having experienced 4 of 6 historic spills, and is therefore biased toward overestimating available water. In addition, given the low frequency and high volume of occurrence, successful capture of the spill water for aquifer storage would be difficult and expensive.

If it is actually determined that unapropriated water is available in a spill year, it is also unclear whether spill water would remain unappropriated. Many entities (regional water planning groups, for example) have taken note that spill water is currently not spoken for and are considering plans for utilizing this water. Any storage or use of this water, either by the Program or by other entities, would require approval of the OSE.

Changes to water timing with no consumptive use component:

As dictated by the Rio Grande Compact, 57% or more of the water that flows past Otowi Bridge must be delivered to Texas. Consequently, there is a large amount of water potentially available for short-term storage by New Mexico in the Middle Valley. Theoretically, water destined for delivery to Texas could be temporarily stored in an aquifer and pumped back into the river during low-flow periods. In reality, however, this option is subject to the same constraints as water storage in up-stream reservoirs and will only be of value for water that cannot be stored in reservoirs due to lack or space, or inability to capture it in a reservoir.

Nonetheless, significant amounts of water may fall into this category, including: Rio Puerco and Rio Salado flows, flows from the drainage channels of the Albuquerque Metropolitan Flood Control Authority (AMAFCA), high flows resulting from monsoon events, etc. Constraints on capture and use of these flows will include: Rio Grande Compact requirements, water quality considerations, and location of available water relative to the proposed aquifer storage and recovery project.

Implementation of aquifer storage and recovery may incur some consumptive use component. There may be small losses associated with recharging the aquifer. More importantly, running water down the Rio Grande during low flow periods (generally summer) rather than during moderate to high-flow periods, would likely result in significantly higher depletions through evapotranspiration. At low flow periods, a higher percentage of the water in the river goes to evaporation than at higher flows. This additional depletion would need to be offset with leased or purchased water rights.

Pumping and Desalinization of Deep Saline Groundwater

River flow could also be supplemented through the pumping and desalization of deep, saline groundwater. This would likely be a very expensive option, but could be considered, should this technology become economically competitive and be ecologically sound. Desalination on a large scale is a fairly new technology, with only a few plants on-line, but is rapidly growing. Prices for water from desalination plants around the world currently range from $1,220 to $2,900 per acre-foot per year ($3.75 to $9.00 per 1,000 gallons). However, new plants proposed for Tampa Bay, FL:

(http://www.tampabaywater.org/MWP/MWP_Projects/Desal/Desal.htm)

and Los Angeles, CA anticipate pricing on the order of $760 per acre-foot per year ($2.08 per 1,000 gallons). In the Rio Grande region, Sandia National Laboratory and the US Bureau of Reclamation are working toward a research desalination plant in the Tularosa Basin (http://wrri.nmsu.edu/tbndrc/tbndrc.html). They are currently preparing a feasibility study and forecast having a plant initially on line in 2004 and at full operation in 2005. There is also proposal in progress for a private desalination plant using water from the Estancia Basin.

The potential for application of desalination technology within the Middle Rio Grande is significant – there are large saline groundwater reservoirs that could be tapped, particularly in the Socorro basin. Saline groundwater basins that are not connected to the Rio Grande could be pumped with no hydrologic impact on the Rio Grande Compact deliveries, although an assessment of local effects would still be required, including impacts on any adjacent freshwater aquifers and the potential for ground subsidence. Groundwater could be pumped with minimal restrictions in undeclared groundwater basins, or at depths greater than the OSE jurisdiction of 2500 feet.

If brackish water from non-tributary basins could be developed, these supplies would augment the supply available for both diversion and consumptive use, and provide significant flexibility in the timing of augmented supplies. From a physical perspective, this option has high potential for improving the water supply to the region. However, it also carries a very high price tag, including the capital costs for the deep wells, land acquisition for and construction of desalination plants, plus operation and maintenance costs, and brine by-product disposal costs (which could be quite significant). There are also ecological concerns associated with the disposal of the high concentration brine by-product.

Conclusions

- Groundwater pumping to supplement river flows is of most use to the program as a method of short-term water storage and recovery, such as for storing of spring flows in the groundwater system of the floodplain for release or natural flow back to the river during low flows of the summer months.
- The volumes of water that could be supplied this way would likely to be sufficient to supplement flows in critical reaches in low-flow periods, or to provide localized flooding to support southwestern willow flycatcher habitat, but would not be sufficient for such purposes as providing spawning pulses or overbank flows.
- The infrastructure required for groundwater pumping that could significantly affect flows would be very large. For comparison, the entire City of Albuquerque wellfield combined pumps a total of approximately 140 cfs.
- Additional depletions associated with the increased summer flows would have to be offset through the purchase or lease of water rights. However, the non-consumptive portion of these flows should be achievable through a permit from the OSE.
- Some potential also exists for the use of aquifer storage and recover in deep wells either in or out of the floodplain, but less directly connected to the river than the floodplain wells. However, there are likely to be very few instances where excess water is available in the system for aquifer recover, unless water rights are specifically purchased or leased for this purpose.
- River flow could also be supplemented through the pumping and desalization of deep, saline groundwater. This would likely be a very expensive option, but could be considered, should this technology become economically competitive and be ecologically sound.